

## Reevaluation of the systematic position of the genus *Tonza* Walker (Yponomeutoidea: family *incertae sedis*), based on *Tonza citrorrhoea* Meyrick, new to Japan

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**Abstract** The previously suggested association of *Tonza* with Plutellidae is reevaluated. One congener, *Tonza citrorrhoea* Meyrick, 1905, is newly recorded from Japan. Adult morphologies of *T. citrorrhoea* are described with photographs and illustrations, and the wing venation and genital structures of *Tonza* are described for the first time. New diagnostic characters are proposed for *Tonza* and they include: antennae almost same length of forewing; forewing with only three radial plus radial sector veins; in male genitalia, both uncus processes and socii present; in female genitalia, lamella antevaginalis strongly sclerotized. These generic characters seem to better associate *Tonza* with Attevidae rather than Plutellidae.

**Key words** Attevidae, generic assignment, genitalia, *Plutella*-group, Ryukyus, Yponomeutidae, wing venation.

### Introduction

The genus *Tonza* was originally described in Plutellidae by Walker (1864). The genus comprises only three species in the world: *T. purella* Walker, 1864 (type species) from Australia; *T. citrorrhoea* Meyrick, 1905 from Sri Lanka and Taiwan; *T. callicitra* Meyrick, 1913 from Papua New Guinea. Meyrick (1905, 1913) described the wing venation of *T. purella* and compared it with the other two species only in the forewing characters. The genitalia of *Tonza* have not been described until now. In fact, the plutellid association of *Tonza* has never been rigorously examined. Common (1990) mentioned that *Tonza* may prove to be related to the Plutellidae, although it has very reduced venation. Heppner (1992) recorded *T. citrorrhoea* under the Plutellidae from Taiwan.

According to Kyrki (1984) the *Plutella*-group in the restricted sense is characterized by the male genitalia with ‘teguminal processes’ curved, surrounding the tuba analis. These processes were erroneously regarded as a gnathos by Dugdale *et al.* (1998) (also see Landry and Hebert, 2013). Kyrki (1990) further mentioned that the Plutellidae differ from the Yponomeutidae by the following characters: 1) ocelli present, 2) sternite of A8 not strongly sclerotized, 3) thoracic leg of larva not long. Of the differences, Dugdale *et al.* (1998) pointed out that in some plutellids, especially so-called “mega-plutellids” from the Southern Hemisphere ocelli are rudimentary or absent. These species were later transferred to Orthoteliinae of Glyphipterigidae. The monophyly of the

Plutellidae *sensu* Kyrki (1990) had already been strongly questioned (e.g. Dugdale *et al.* 1998). A recent molecular phylogenetic study (Sohn *et al.*, 2013) proposed 11 families within Yponomeutoidea which correspond to 10 yponomeutoid families defined by van Nieukerken *et al.* (2011) on morphological grounds plus the Scythropiidae. Unfortunately, none of the previous phylogenetic studies for Yponomeutoidea included *Tonza* for their analyses.

In this paper, *T. citrorrhoea* is newly recorded from Japan, and the wing venation and genital features of the genus *Tonza* are described with photographs and illustrations for the first time. In addition, we revise the definition of the genus and discuss its taxonomic position based on morphological characters.

### Materials and methods

Specimens were collected by light trap in June 2014 in the Okinawa Is. and April 2015 in the Yonaguni Is. in Okinawa Prefecture, Japan. For preparation of the male and female genitalia, the abdomen was removed and boiled for 5 min in 10% aqueous KOH. These were stained with acetocarmine. All Japanese specimens were deposited in the Entomological Laboratory, Osaka Prefecture University (OPU). Terms for genitalia mainly follow Sohn & Nishida (2011) and Nasu *et al.* (2011). Terms for wing venation follow Wootton (1979).

### Taxonomy

#### Genus *Tonza* Walker

*Tonza* Walker 1864: 1011; Meyrick, 1905: 614; Meyrick,

1913: 146.

Type species: *Tonza purella* Walker, 1864.

**Diagnosis.** The yponomeutoid association of this genus is substantiated by the presence of two autapomorphies for the superfamily: the presence of posterior expansions of male pleuron VIII (Fig. 1I) and a transverse ridge behind the anterior margin of sternum II (Fig. 1H). The diagnostic features of the genus include: antennae slightly longer or same length as forewing (Fig. 1A); forewings with slightly protruding apex and tornus; forewing termen oblique or concave; only two radial sector veins present, RS1 on apex and RS2 on termen (Fig. 1F); in the male genitalia (Fig. 2A–D), uncus small with a pair of long processes; socii with long terminal setae; valva elongate with several small spines and plate arising from middle to base of valva. In the female genitalia (Fig. 2E–F), lamella antevaginalis sclerotized, covering sternite VIII; antrum slender; inception of ductus seminalis at the middle of corpus bursae.

**Original description:** “Male. Body slender. Head prominent. Frontal tuft conical, extending somewhat beyond the head. Proboscis obsolete. Palpi porrect, hardly ascending, smooth, slender, extending beyond the head; third joint lanceolate, nearly as the second. Antennae smooth, full as long as fore wings. Abdomen extending somewhat beyond the hind wings. Legs smooth, very slender; spurs very long. Wings long. Fore wings slightly rounded at the tips, slightly widening from the base to the interior angle; exterior border slightly oblique, hardly concave.

Type, *T. purella*.”

**Additional description:** Head (Fig. 1D–E). Ocelli absent. Chaetosemata absent. Maxillary palpus small, 3-segmented. Labial palpus upcurved, 3-segmented. Wing venation (Fig. 1F–G). Forewing veins (Fig. 1F). Pterostigma absent; R from middle of cell to apex; RS1 and RS2 stalked, from end of cell to apex and RS2 to termen. M stem vein indistinct. CuP present. Hindwing veins (Fig. 1G). M1 and M2 separated; M3+CuA1 and CuA2 branched.

Abdomen. Tergum smooth without spiniform setae. Male 8th abdominal segment (Fig. 1I) with a pair of coremata; a pair of pleural lobes elongate, lobate, each dorsal side fused with narrow, tapering tergum VIII.

Male genitalia (Fig. 2A–D). Uncus obsolete with a pair of long processes. Socii with long terminal setae. Tuba analis weakly sclerotized. Teguminal processes with dense setae on terminal 1/2. Gnathos absent. Tegumen oblong. Valva (Fig. 2A) elongate with several small processes, setae and plates arising from base to middle

inside valva. Vinculum U-shaped; saccus slender. Aedeagus (Fig. 2D) straight, slender without cornuti.

Female genitalia (Fig. 2E–F). Papillae anales narrow. Apophysis anterioris and apophysis posterioris slender. Sternite VIII with hairy small humps on the distal margin; Lamella antevaginalis sclerotized, covering basal half of sternite VIII. Ostium bursae small. Antrum slender; inception of ductus seminalis on the middle of corpus bursae. Corpus bursae globular, without a signum. Host plants. Unknown.

**Distribution.** Australia (Queensland) (Walker, 1864); Sri Lanka (Hantane) (Meyrick, 1905); China (Taiwan) (Heppner, 1992); Papua New Guinea (Bougainville Is.) (Meyrick, 1913); Japan (Okinawa Prefecture: new record).

**Remarks.** This genus is similar to *Atteva* Walker, 1854 (Attevidae) in the male genitalia but differs from the latter by the lack of a pair of sclerotized rods on the male sternite VIII and the aedeagus lacking a spinulate zone of cornuti. This genus is also similar to *Acrolepiopsis* Gaedike, 1970 (Yponomeutidae) in the female genitalia but differs from the latter by having a sclerotized lamella antevaginalis.

**Included species**

*Tonza purella* Walker, 1864

*Tonza citrorrhoea* Meyrick, 1905

*Tonza callicitra* Meyrick, 1913

***Tonza citrorrhoea* Meyrick, 1905 (Figs 1–2)**

*Tonza citrorrhoea* Meyrick, 1905: 614; Heppner, 1992: 74.

Type locality: Sri Lanka (Hantane).

**Diagnosis.** According to Meyrick (1913), this species differs from its two other congeners in the shape and coloration of the forewings (Table 1). This species is superficially similar to some ‘crambid moths’ (e.g. *Ancylolomia japonica* Zeller, 1877) in the forewing pattern and shape but can be easily distinguished from the latter in having longer antennae, more slender labial palpus, and narrower hindwing.

**Original description:** “♂. 16 mm. Head white, loosely rough-haired on crown but not tufted, face pale yellow. Palpi, antennae, thorax, and abdomen pale whitish-yellow. Forewings elongate, narrow, terminally dilated, costa slightly sinuate, apex round-pointed, termen concave, rather oblique, tornus prominent, round-pointed; white, with series of pale fuscous transverse strigulae between veins; costal half except towards termen, and veins on terminal area suffused with pale brassy-yellow; margins of cell, and tornal veins dotted with dark fuscous; minute blackish dots at apex and

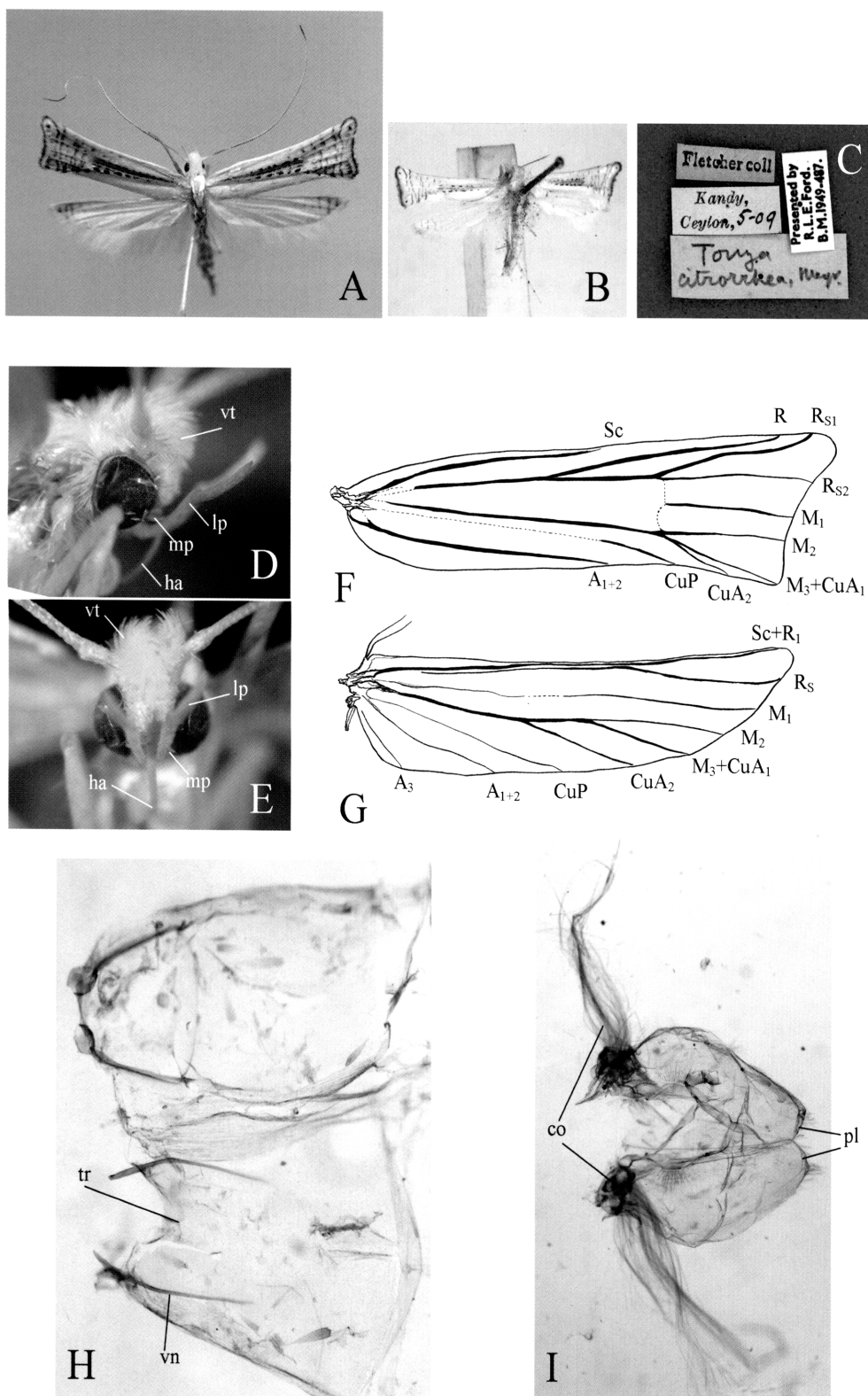


Fig. 1. Generic characteristics of *Tonza citrorrhoea*. A. Adult ♀ (Okinawa Pref., Japan). B. Adult (Kandy, Sri Lanka). C. Labels of B. D. Head (lateral view). E. Head (front view). F. Forewing ♀. G. Hindwing ♀. H. Abdominal segment II-III of ♂. I. 8th abdominal segment of ♂, ventral view. Abbreviations: co: coremata; ha: haustellum; lp: labial palpus; mp: maxillary palpus; pl: pleural lobe; tr: transverse ridge; vn: venula; vt: vertex tuft.

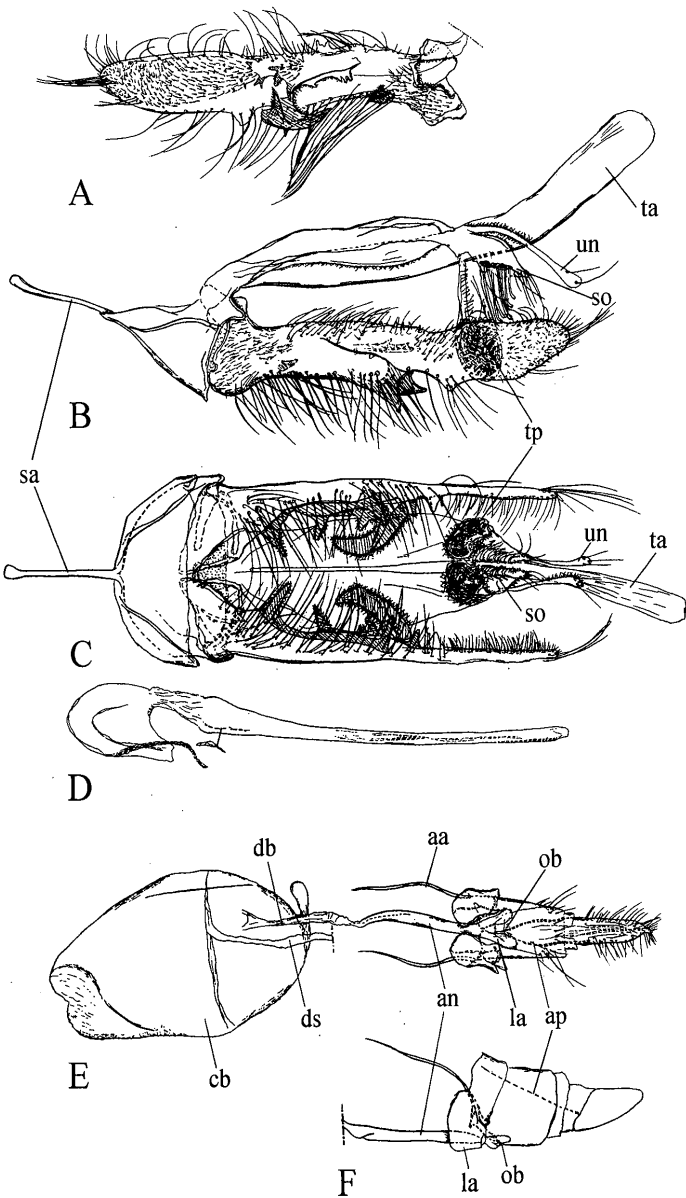


Fig. 2. The genitalia of *Tonza citrorrhoa*. A. Left valva. B. Male genitalia, lateral view. C. Ventral view. D. Aedeagus, ventral view. E. Female genitalia, ventral view. F. Lateral view. Abbreviations: aa: apophysis anterioris; an: antrum; ap: apophysis posterioris; cb: corpus bursae; db: ductus bursae; ds: ductus seminalis; la: lamella antevaginalis; ob: ostium bursae; sa: saccus; so: socius; ta: tuba analis; tp: teguminal processes; un: uncus.

Species name	Shape		Coloration
	Termen	Tornus	
<i>Tonza citrorrhoa</i>	more concave	more prominent	yellow in middle area
<i>T. callicitra</i>	less concave	less prominent	yellow in dorsal area
<i>T. purella</i>	oblique	least prominent	speckled with grey scales

tornus; cilia whitish, becoming pale yellowish posteriorly, with a dark brownish postmedian line. Hindwings whitish, towards apex yellowish-tinged and with a few grey strigulae; cilia white.”

**Additional description:** Adult (Fig. 1A–B). Wing expanse 14.0 mm, forewing length 7.0 mm (n=2). Head (Fig. 1D–E) white; frons pale yellow and vertex white. Maxillary palpus ochreous, 3-segmented. Labial palpus ochreous to brown, upcurved, with 1st segment one fourth length of 2nd, 2nd segment as long as 3rd. Antennae 1.1x length of forewing, yellowish white annulated with dark brown, apical segment dark brown. Fore legs with coxa white, femur and tibia pale yellow to golden, epiphysis pale yellow, dark brown apically; middle legs pale yellow, two apical spurs white, dark brown apically, tarsus dark brown apically; hind legs white with coxa peppered with yellow scales, medial and apical spurs golden, dark brown apically, tarsus with three dark brown bands. Forewing and hindwing: See original description.

Wing venation (Fig. 1F–G). Forewing with ten veins; Sc along costal fold, ending at middle of costa; pterostigma absent; R from middle of cell to costa; RS1 and RS2 stalked, RS1 from end of cell to costa. RS2, M1 and M2 from end of cell to termen; M3+CuA1 and CuA2 stalked, from end of cell to tornus; CuP weak, from base and reaching dorsal area; A1+2 from base to middle of dorsum. Hindwing with nine veins; Sc+ R1 along costa, reaching apex; RS from base to apex; M1 from base ending at middle of termen; M2 from base ending at tornus; M3+CuA1 and CuA2 branched; CuP from base ending at middle of dorsum; A1+2 from base ending at one third of dorsum; A3 from base ending at base of dorsum.

Male 8th abdominal segment (Fig. 1I). Coremata about 1.5x length of pleural lobes.

Male genitalia (Fig. 2A–D). Uncus small, linguiform with a pair of long, slender, weakly developed processes. Socii semielliptical, 3/5 length of saccus, with long terminal setae, slightly curved apex. Tuba analis weakly sclerotized, longer than aedeagus. Teguminal process large, developed, as long as saccus, with dense setae on distal 1/2. Valva (Fig. 2A) elongate, narrow, round at apex; small digitate processes arising from 2/3 ventral side of valva; a stout J-shaped process arising from 1/2 ventromedial side of valva; a sclerotized narrow plate from nearly base to 1/2 of valva, with two spiniform processes; several scattered spines from 1/2 to 1/3 inside and on dorsal side of valva. Vinculum U-shaped; saccus with a narrow basal plate and a slender process, 1/3 length of valva. Aedeagus (Fig. 2D) slender, about same

length of valva; some weak wrinkles present on basal area.

Female genitalia (Fig. 2E–F). A pair of semicircular depressions on lateral angle. Ostium bursae slender, H-shaped. Antrum slender, slightly curved; ductus bursae as long as antrum, tubular; inception of ductus seminalis on the middle of corpus bursae. See the generic description for other characters.

**Distribution.** Sri Lanka (Hantane) (Meyrick, 1905); China (Taiwan) (Heppner, 1992); Japan (Okinawa Prefecture: new record).

**Specimens examined.** 12 (4♂ 3♀ 5exs)

Adults: Japan: Ryukyus: Okinawa Prefecture: 2♀, Shiokawa, Motobu, 20. vi. 2014, A. Miyano leg., SK538, 539. 4♂ 1♀ 5exs, Kubura-dake, Yonaguni Is., 16. iv. 2015 (L. T.), M. Kimura leg., SK540–543.

**Host plants.** Unknown.

## Discussion

Since the original description, *Tonza* has been treated as a member of the Plutellidae (Common, 1990; Heppner, 1992). However, no previous publication provided convincing evidence supporting the plutellid association of *Tonza*. In the present study, we examined the adult characters of *Tonza* and compared it with other yponomeutoids (Tables 2–3).

*Tonza* does not possess ocelli on the head. This character alone disputes its association with Plutellidae, Ypsolophidae, and two glyphipterigid subfamilies, Glyphipteriginae and Acrolepiinae. The plutellid association of *Tonza* is further undermined by the absence of the diagnostic characters for the family proposed by Kyrki (1984, 1990). *Tonza* lacks the spiniform setae on the terga and the basal scape on the aedeagus, two characters defining Yponomeutidae. The genital features of *Tonza* exclude its association with Argyresthiidae, Scythropiidae, Bedelliidae, Heliodinidae, and Lyonetiidae.

Kyrki (1984) defined Attevidae with two characters: the presence of chaetosemata on the head, the reduced hind tibia and tarsi (particularly in males), and the absence of the hind tibial spurs in males. These characters are not found in *Tonza*. It is, however, noteworthy that the male genitalia and abdominal segment VIII of *Tonza* show several similarities to those of Attevidae: e.g. the presence of uncal processes and socii and the form of posterior expansion of male pleuron VIII. Further, *Tonza* shares at least five general features for Attevidae listed by Dugdale *et al.* (1998): i.e. the antennal scape without

Table 2. Adult diagnostic features of genus *Tonza* and yponomeutid families (Head, Forewing, Abdomen).

Taxa	Head				Forewing			Abdomen					
	Ocelli	Chaet- osema	No. of segments of maxillary palpus	2nd segment of labial palpus	Length of antenna compaired with forewing	Scape of antennae	Pter- ostigma	No. of R veins	Transverse costa of A2	Spiniform setae of tergum A2-A7	Sternite	Pleural lobes	Coremata
<i>Tonza</i>	- **	-	3	smooth	long (1.0~1.1 x)	Smooth	-	3	+	-	normal	+	+
Plutellidae* ( <i>Plutella</i> group)	+	-	3	scale brush	short	Smooth	+	5	+	-	normal	+	+—
Yponomeutidae*	-	-	1-4	smooth	short	with scale flap or pecten	+	5	+	+	sclerotized	+	+
Ypsolophidae*	+	-	4	scale brush	short	with scale flap	+—	5	—†	-	normal	+	+, long
Glyphipterigidae*	+	-	4	smooth	short	smooth	+	5	+	-	forming conical lobe	-	-
Argyresthiidae*	-	-	1	smooth	short	with pecten	+	5	+	-	strongly sclerotized	+	+
Lyonetiidae*	-	-	-	-	long (0.8~1.5 x)	with eye-cap	-	2-4	+—	+	forming processes‡	-	+—
Attevidae*	-	+	3	smooth	short	smooth	-	5	+	-	sclerotized	+	?
Praydiidae*	-	-	1	smooth	short	smooth	+	5	+	-	strongly sclerotized	+	+
Heliodinidae*	+	-	2	smooth	short	smooth	-	4	+	-	normal	+	-
Bedelliidae*	-	-	1	smooth	long (1.0 x)	with pecten	-	4	+	-	normal	-	-
Scythropiidae*	-	-	4	smooth	short	with pecten	+	5	+	-	sclerotized	+	?

\*Reference: Kyrki (1984, 1990), Dugdale *et al.* (1998), Nasu *et al.* (2011), Sohn & Wu (2013); \*\* +: present, -: absent; †Ochsenheimeriinae

‡Forming super uncus (Lyonetiidae), forming a pair of sclerotized processes (Cemiostominae).

Table 3. Adult diagnostic features of the genus *Tonza* and yponomeutid families (Genitalia).

Taxa	Male genitalia					Female Genitalia			
	Uncus	Socii	Teguminal processes	Gnathos	Valva	Scape / cornutii / coecum of Aedeagus	Lamella postvaginalis (hairy humps)	Lamella antevaginalis	Signum
<i>Tonza</i>	small with a pair of long processes	small with long terminal setae	large, with dense setae	–	elongate with several process	– / – / –	1, rounded	+	–
Plutellidae* ( <i>Plutella</i> group)	–	–	sclerotized setose lobes	narrow band	rounded	– / + / +	2	–	–
Yponomeutidae*	semi-elliptical to oblong	long hairy lobe	–	band	elongate, rounded	+ / – / +	2	–	+
Ypsolophidae*	small with short setae	oblong, rounded	–	long, forming ventral plate	rounded	– / + / +	2	–	+
Glyphipterigidae*	–	–	–	–	small, rounded	– / – / –	2	–	–
Argyresthiidae*	oblong	small with special scales at apex	–	small band	rounded	– / + / –	1, rounded	–	+
Lyonetiidae*	–	–	–	A pair of small processes	rounded	– / + / –	–	+	–
Attevidae*	small with a pair of short processes	slender with special scales	–	developed with medial plate	elongate	– / + / –	1, rounded	–	+
Praydidae*	–	hairy process	–	band	slender with process	– / + / –	2	–	+
Heliodinidae*	–	–	–	long, narrow band	elongate	– / – / –	–	–	+
Bedelliidae*	–	–	–	narrow band	rounded with small spine at apex	– / – / –	–	–	+
Scythropiidae*	oblong	small with unscaled	–	band	rounded lobe	– / + / –	–	+	–

\*Reference: Kyrki (1984, 1990), Dugdale *et al.* (1998), Nasu *et al.* (2011), Sohn & Wu (2013); \*\* +: present, –: absent.

The term ‘teguminal processes’ has been used by Kyrki (1984) to designate the paired, setose structures that extend from the posterior margin of the tegumen. (see Landry and Hebert, 2013)

pectens; the maxillary palpi 3-segmented; the pterostigma absent on the forewing; the abdominal terga without spiniform setae; and the aedeagus without a scape. With the discovery of the Pumattevinae, Heppner (2015) revised the major features of the Attevidae. Interestingly, the Pumattevinae also lack two autapomorphies for the Attevidae proposed by Kyrki (1984). Heppner (2015) proposed the presence of abdominal sclerotized spots as a new autapomorphy for the family. This character does not occur in *Tonza*. A putative plutellid genus, *Stachyotis* possesses two pairs of processes on the uncus as well as the teguminal processes (Sohn, 2014). This character state appears similar to *Tonza*. Both genera, however, differ in the shape of the pleural lobes. Several morphological features of *Tonza* clearly dispute its plutellid association. Our observations may hint at the Attevidae as a possible alternative family for *Tonza*. A formal family transfer must however wait until the immature stages of *Tonza* become known.

The Yponomeutoid fauna of the Oriental Region and the Southern Hemisphere are poorly known (Nasu *et al.*, 2011). A thorough inventory of the fauna may reveal species filling the morphological gaps between *Tonza* and Attevidae.

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## 摘要

日本初記録の*Tonza*属 (スガ上科, 所属未定) の分類学的位置の再評価 (小林茂樹・Jae-Cheon SOHN・吉安 裕)

*Tonza*属 (スガ上科) は, コナガ科の一属として南アジアとオーストラリア地域から3種が記載された小型の蛾類である。成虫は, 開張15 mm内外で前翅は白色で淡色条が中央に走り, 周囲に黒点が散在する。3種は, 前翅の翅頂の形状で識別できる。本属は, 1900年初頭の記載以降, 形態



に関する記載がなく、またコナガ科の他の属に比べて翅脈が著しく退化しており、その所属に疑問があった。

2014, 2015年に沖縄県で灯火採集によりえられたツトガに似た斑紋をもつ標本を詳細に観察した結果、日本初記録の本属の一種であることが明らかになった。成虫の形態を詳細に記載し、本種の翅脈および本属の雌雄交尾器を初めて明らかにした。コナガ科を含むスガ上科の11科と成虫形態を比較した結果、本属は、コナガ科の共有形質を欠き、その他の形質からもコナガ科への所属には疑いがあり、むしろ熱帯域に分布するアテバガ科Attevidaeに雄交尾器などの特徴が似ていた。しかし、所属する科の決定には、幼虫、蛹の形態を解明すること、南半球のスガ上科相と比較し有用な形質を探索する必要がある、今回は科の扱いを保留した。

*Tonza citrorrhoa* Meyrick, 1905

エグレカイハネガ（新称，新記録種）(Figs 1–2)

開張14.0 mm. 前翅は白色で翅中央に淡色条が走り、黒点が散在する。翅頂と後角部がが突出し翅縁の中央部はへこむ。前翅のR脈は3本で縁紋を欠く。雄交尾器のウックスは一对の細長い突起をもち、ソキウスとテグメンの突起は発達し、グナトスを欠く。バルバは、中央に硬化した複数の突起をもつ。雌交尾器のラメラ・アンテバギナリスは、強く硬化し、ラメラ・ポストバギナリスは発達せず、コルプス・ブルサエにシグナをもたない。幼生期は不明。灯火で一度に複数個体が採集されている。和名は、翅形が船を漕ぐ櫂の形に似ることになむ。

分布：沖縄（沖縄島、与那国島）；台湾、スリランカ。寄主植物：不明

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